CLAIMS

What is claimed is:

1. A composition comprising:

a matrix, wherein the matrix exhibits a phase change between about 30° C and about 100° C; and

a distribution of first interstitial heat transfer structures in the matrix, including a size range from about 5 micron to about 25 micron, and wherein the distribution of first interstitial heat transfer structures occupies from about 5 volume percent to about 95 volume percent of the composition.

2. The composition of claim 1, wherein the distribution of first interstitial heat transfer structures is selected from aluminum, aluminum alloys, copper, copper alloys, silver, silver alloys, tin, tin alloys, dielectrics, graphite, carbon fibers and combinations thereof.

3. The composition of claim 1, further including a distribution of second interstitial heat transfer structures, wherein the distribution of second interstitial heat transfer structures includes a low melting-point metal.

4. The composition of claim 1, further including a distribution of second interstitial heat transfer structures, wherein the distribution of second interstitial heat transfer structures is present in a greater weight concentration than the distribution of first interstitial heat transfer structures.

5. The composition of claim 1, wherein the matrix is selected from silicone, an amino epoxy, an acrylate, an olifin resin, a vinyl, an acrylic, a natural rubber, and a synthetic rubber.

6. The composition of claim 1, wherein the matrix is selected from silicone, an amino epoxy, an acrylate, an olifin resin, a vinyl, an acrylic, a natural rubber, and a synthetic rubber, and wherein the wetting agent is present from about 1 to about 25 percent, the matrix is present from about 4 to about 75 percent, and the interstitial heat transfer structures are present from about 5 to about 95 percent.

7. An article comprising:

a matrix including a first surface and a second surface that is parallel planar to the first surface, wherein the matrix exhibits a phase change between about 30° C and about 100° C;

a distribution of first interstitial heat transfer structures in the matrix, including a size range from about 5 micron to about 25 micron, and wherein the distribution of first interstitial heat transfer structures occupies from about 5 volume percent to about 95 volume percent of the composition; and

wherein the first surface is separated from the second surface by less than or equal to about 30 micron.

8. The article of claim 7, wherein a contiguous interstitial heat transfer structure path originates at the first surface and terminates at the second surface, and wherein the contiguous interstitial heat transfer structure path includes four or fewer interstitial heat transfer structures.

9. The article of claim 7, further including:

a distribution of second interstitial heat transfer structures, wherein a portion of the distribution of second interstitial heat transfers includes one interface exposed at least one of the first surface and the second surface, and one interface exposed to at least one of the distribution of first interstitial heat transfer structures.

10. The article of claim 7, further including:

a distribution of second interstitial heat transfer structures, wherein a portion of the distribution of second interstitial heat transfer structures includes one interface exposed at least one of the first surface and the second surface, and one interface exposed to at least one of the distribution of first interstitial heat transfer structures, and wherein the distribution of second interstitial heat transfer structures is present in a greater weight concentration than the distribution of first interstitial heat transfer structures.

11. The article of claim 7, wherein the matrix is selected from silicone, an amino epoxy, an acrylate, an olifin resin, a vinyl, an acrylic, a natural rubber, and a synthetic rubber.

12. The article of claim 7, wherein the matrix is selected from silicone, an amino epoxy, an acrylate, an olifin resin, a vinyl, an acrylic, a natural rubber, and a synthetic rubber, and wherein the wetting agent is present from about 1 to about 25 percent, the matrix is present from about 4 to about 75 percent, and the interstitial heat transfer structures are present from about 5 to about 95 percent.

13. A package comprising:

a die;

a first heat sink;

a thermal interface material disposed between the die and the first heat sink, the thermal interface material including:

a matrix, wherein the matrix exhibits a phase change between about 30° C and about 100° C; and

a distribution of first interstitial heat transfer structures in the matrix, including a size range from about 5 micron to about 25 micron, and wherein the distribution of first interstitial heat transfer

structures occupies from about 5 volume percent to about 95 volume percent of the composition; and

wherein the die is separated from the first heat sink by less than or equal to about 30 micron.

14. The package of claim 13, further including:

a second heat sink disposed above the first heat sink.

15. The package of claim 13, further including:

a second heat sink disposed above the first heat sink; and

a thermal interface material disposed between the first heat sink and the second heat sink, including:

a second heat sink matrix, wherein the second heat sink matrix exhibits a phase change between about 30° C and about 100° C; and

a distribution of first interstitial heat transfer structures in the second heat sink matrix, including a size range from about 5 micron to about 1,000 micron, and wherein the distribution of first interstitial heat transfer structures occupies from about 5 volume percent to about 95 volume percent of the composition.

16. The package of claim 13, wherein the matrix is selected from silicone, an amino epoxy, an acrylate, an olifin resin, a vinyl, an acrylic, a natural rubber, and a synthetic rubber.

17. The package of claim 13, wherein the matrix is selected from silicone, an amino epoxy, an acrylate, an olifin resin, a vinyl, an acrylic, a natural rubber, and a synthetic rubber, and wherein the wetting agent is present from about 1 to about 25 percent, the matrix is present from about 4 to about 75 percent, and the interstitial heat transfer structures are present from about 5 to about 95 percent.

18. The package of claim 13, wherein the die includes a bare die.

19. The package of claim 13, wherein the die includes a bare die in a mobile device.

20. A method comprising:

assembling a package, the package including:

a die;

a heat sink; and

a first thermal interface material disposed between the die and the heat sink, the first thermal interface material including:

a matrix, wherein the matrix exhibits a phase change between about 30° C and about 100° C; and

a distribution of first interstitial heat transfer structures in the matrix, including a size range from about 5 micron to about 25 micron, and wherein the distribution of first interstitial heat transfer structures occupies from about 5 volume percent to about 95 volume percent of the composition;

removing the first thermal interface material; and

applying a second thermal interface material.

21. The method of claim 20, before removing the first thermal interface material, the method including:

operating the die under conditions to cause the matrix to change phase.

22. The method of claim 20, wherein removing the thermal interface material is carried out at a temperature selected from room temperature and a temperature above room temperature.

23. The method of claim 20, further including:

a distribution of second interstitial heat transfer structures, wherein the distribution of second interstitial heat transfer structures includes a low melting-point metal, the method further including:

removing the thermal interface material at a temperature of at least the solidus temperature of the distribution of second interstitial heat transfer structures.

24. The method of claim 20, wherein removing the thermal interface material includes removing from a bare die.

25. The method of claim 20, wherein the thermal interface material includes removing from a bare die in a mobile device.

26. A computing system comprising:

a die;

a first heat sink;

a thermal interface material disposed between the die and the first heat sink, the thermal interface material including:

a matrix, wherein the matrix exhibits a phase change between about 30° C and about 100° C; and

a distribution of first interstitial heat transfer structures in the matrix, including a size range from about 5 micron to about 25 micron, and wherein the distribution of first interstitial heat transfer structures occupies from about 5 volume percent to about 95 volume percent of the composition;

wherein the die is separated from the first heat sink by less than or equal to about 30 micron; and

at least one of an input device and an output device coupled to the die.

27. The computing system of claim 26, wherein the computing system is disposed in one of a notebook computer, a desktop computer, a wireless communicator, a hand-held device, an automobile, a locomotive, an aircraft, a watercraft, and a spacecraft.

28. The computing system of claim 26, wherein the die is selected from a data storage device, a digital signal processor, a micro-controller, an application specific integrated circuit, and a microprocessor.

29. The computing system of claim 26, wherein the die includes a bare die.

30. The computing system of claim 26, wherein the die includes a bare die in a mobile device.